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STRATOSPHERIC POLLUTANT TRANSPORTS BY PLANETARY WAVES AND TROPICAL CIRCULATIONS

Final Report

by

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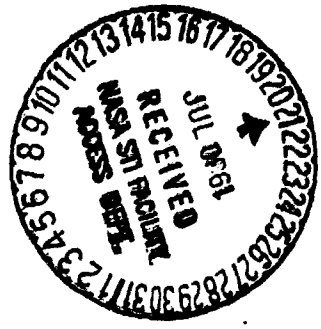

July 1979 to March 1980

Cooperative Agreement NCC 2-17

San Jose State University
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Final Report for

Dr. Leonhard Pfister

(This report includes work completed through mid-March, 1980, when the agreement was terminated four months prior to its original expiration date.)

Substantial progress has been made in analyzing the radiosonde and U-2 aircraft data from the NASA ITCZ experiment of July, 1977. The first stage of the analysis involved plotting the radiosonde data above 15km in the form of time-height sections, so that wave motions in the meteorological variables (temperature, zonal wind, and meridional wind) could be easily delineated. Ozone data was also analyzed; however, the drift in the instrument was too great and sounding-to-sounding accuracy insufficient to yield usable data for anything but features of very small vertical scale. The data was first filtered in the vertical to remove fluctuations with vertical wavelengths less than 3km.

The results showed the presence of the planetary 16-day Kelvin wave, in accordance with previous observational and theoretical studies. More significantly, large amplitude gravity waves with vertical wavelengths on the order of 3-6km were found. Spectral analysis of frequencies showed peaks in meridional wind variance at 2-3 days and 5 days, with the shorter periods stronger at higher altitudes. In the time domain, two instances of organized wave groups propagating upward into the stratosphere were isolated. Associated with one of these wave groups was a region of very large vertical shear in which either turbulence or small scale (10km wavelength or less) gravity wave activity had been found by the U-2 aircraft.

This last result is of potential significance, since it suggests that vertical mixing may be occurring, and that this vertical mixing is associated with the large amplitude, "short period" (5 days or less) gravity waves. The next step was then to compute the Richardson number (essentially an indicator of the likelihood of turbulent or small-scale-wave mixing) as a function of time and height. This computation indeed showed near-unstable values associated with one of the gravity wave groups, and a number of other instances as well. Of interest also was the presence of extensive zones of low Richardson numbers at altitudes above 27km. Portions of this work will be presented at the Symposium on Middile Atmosphere Dynamics and Transport at Urbana, Illinois in July, 1980.

Progress has also been made in a theoretical analysis of possible baroclinic instability in the summer mesosphere. Results indicate that anticipated kinds of horizontal variations in the mean flow field are less likely to inhibit instability under summer mesospheric conditions than under the winter upper stratospheric conditions studied previously. Horizontal wavenumbers also appear to be significantly lower than in the winter upper stratosphere.